

REVIEW

Advanced methods in the surgical treatment of pancreatic tumors

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ABSTRACT

The basic method of treating patients with pancreatic tumors is surgery, which involves complete removal of the tumor. The growing experience of surgeons and improved technical capabilities make it possible to perform extensive resections without increasing the complication rate. Whipple's pancreaticoduodenectomy remains the standard treatment method for patients with a head tumor or an uncinate process of the pancreas. Modifications of this method that allow preservation of the pylorus do not affect long-term oncological results. Involvement of large arterial vessels was a contraindication for resection in patients with pancreatic tumors. Involvement of the middle mesenteric vein is not in itself a criterion of inoperability. Current surgical practices have described a regional pancreatectomy approach that includes "en bloc" resection of the peripancreatic soft tissue, regional lymph nodes with resection of the portal vein, and the superior mesenteric artery. "Minimally invasive" surgical procedures, performed through a small incision, are preferred in the treatment of pancreatic tumors. The technologies used today are considered the most important developments in modern surgery and offer many advantages for patients and doctors compared to classic open surgery. Laparoscopic and robotic surgery, compared to open surgery, minimize the length of hospital stay and offer the patient a faster recovery.

Keywords: pancreatic tumor, laparoscopic, robotic, surgery

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Introduction

The most important goal in the treatment of patients with pancreatic adenocarcinoma has always been its complete removal. In the last twenty years, the importance of chemotherapy or chemoradiotherapy prior to surgery has increased. Combined with the use of vascular reconstruction techniques, this has enabled the complete removal of tumors that were previously considered inoperable¹. A pancreatic tumor in the early stage is usually a clinically silent tumor, and symptoms only appear when it affects the surrounding tissues or develops distant metastases. Most patients with pancreatic tumor symptoms are already at an advanced stage when the diagnosis is made². Important access to modern imaging techniques allows proper assessment of the lesion before surgery. Abdominal CT remains the best tool in the initial diagnosis of a pancreatic tumor and assessment of its stage of advancement. The best assessment is achieved by a combination of several methods of organ imaging, such as contrast CT, endoscopic ultrasound, magnetic resonance, and especially MR cholangiopancreatography^{3,4}. During an endoscopic ultrasound examination, tissue samples can also be taken, or a fine needle aspiration biopsy can be performed. CT and MRI scans enable the assessment of vascular invasion, the condition of the lymph nodes and the detection of even small metastases (3-5 mm in diameter)^{5,6}. Although there are no randomized studies, the results of follow-up studies have shown that in patients with advanced pancreatic tumor involving the portal vein, superior mesenteric vein, and the terminal part of the splenic vein, surgical treatment can increase the 5-year survival rate to 23%, provided that complete recovery is achieved. - R0 resection^{7,8}. The growing experience of surgeons and improved technical capabilities make it possible to perform extensive resections without a statistically significant increase in the incidence of perioperative complications, which has been confirmed in numerous retrospective analyses^{9,10}. During a classical Whipple procedure, it is technically difficult to remove a tumor on the head of the pancreas that infiltrates the superior mesenteric vein, the portal vein and the terminal part of the splenic vein, because the pancreas cannot be resected in a typical way, i.e. the border of the head and body. Then it is recommended

to perform a modified pancreaticoduodenectomy, known as the WATSA (Whipple at the Splenic Artery) procedure^{11,12} (Figure 1).

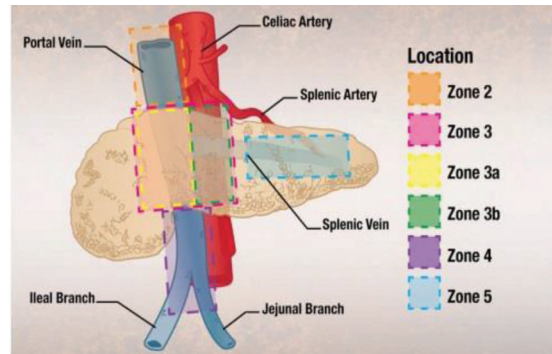


Figure 1. Zones of vein involvement. Zone 1 (not shown) extends from the hilum of the liver to the hepatoduodenal ligament (zone 2). Zone 3 marks the splenic vein/portal vein confluence and is further divided into right (3a) and left (3b). Zone 4 extends inferiorly from the estuary and includes the ileal and jejunal branches. Zone 5 extends along the splenic vein.

During this operation, the resection line of the pancreas is moved to the left by approximately 1-2 cm, to the point where the splenic artery reaches the upper border of the pancreas. The lines of resection of the walls of the portal vein and the superior mesenteric vein then run approximately 1 cm from the tumor. If technically possible, the cut vessels are anastomosed by end to end anastomosis. Otherwise, it is necessary to implant a vein graft or a plastic vascular prosthesis^{13,14} (Figure 2).

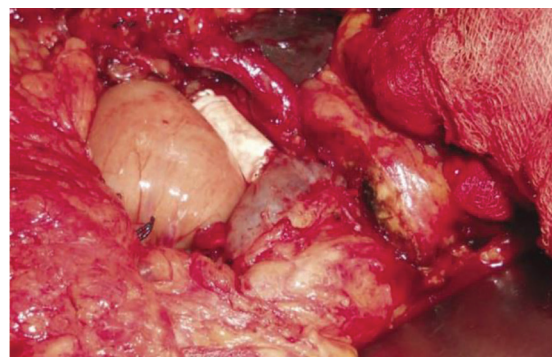


Figure 2. The resected part of the portal vein replaced by a 10mm PTFE prosthesis.

Preliminary results confirm the effectiveness and safety of this method used in pancreatic surgery centers. It enables a higher rate of R0 resections without increasing the rate of perioperative complications. Previous short-term observation of patients undergoing this procedure did not show the development of left portal hypertension after ligation of the splenic vein¹⁵.

Results of previous research

There are more and more reports in the literature that confirm the possibility of vascular reconstruction after extensive tumor resections in the pancreaticoduodenal area. In 2012, Kaneoka et al. described the possibility of using a patient's own vein graft for vascular transplantation, to reconstruct the superior mesenteric vein, the portal vein, the hepatic vein, or the inferior vena cava after extended resection procedures for pancreatic tumors and ampulla of Vater¹⁶. They determined that the use of autologous material reduces the risk of developing infections, and ensures better patency of the reconstructed vessel compared to that observed after the installation of a prosthesis made of synthetic materials. The great saphenous vein, which is commonly used in vascular surgery, can be used for reconstruction¹⁷ (Figure 3).

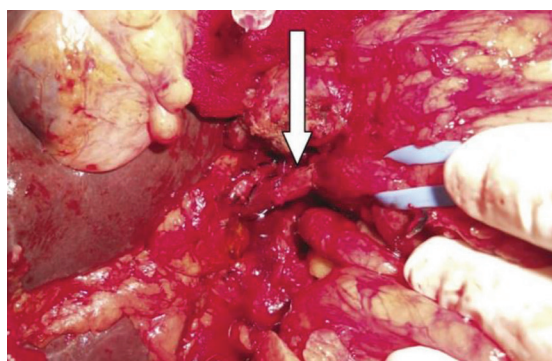


Figure 3. Reconstruction of the resected portal vein with a VSM graft.

The safety of extensive pancreatic head resections combined with resection of the portal vein or superior mesenteric vein has also been demonstrated in many European studies. Müller et al. performed such operations on almost 500 patients with an advanced

type of pancreatic tumor, and found the influence of the reconstruction method on the frequency of perioperative complications or mortality. At the time of diagnosis, more than 50% of patients have distant metastases, and the tumor is considered potentially resectable in 15-20%¹⁸. The European Society of Medical Oncology (ESMO) recommends the inclusion of patients with potentially operable tumors in clinical trials evaluating the benefit of chemotherapy or chemoradiotherapy before surgery. The biological characteristics of pancreatic adenocarcinoma that contribute to its highly aggressive course and rapid formation of distant metastases mean that patients with locally advanced pancreatic tumors may benefit from this type of treatment. There are some papers that present the reduction of the tumor mass, even achieving resectability, thanks to the application of neoadjuvant chemotherapy or chemoradiotherapy in patients with locally advanced tumors with vascular invasion, which were previously considered to be marginally resectable or unresectable¹⁹. The optimal neoadjuvant regimen has not yet been established, but it is in the phase of clinical trials. Some studies have observed a statistically significant increase in the incidence of perioperative complications among patients who underwent neoadjuvant radiotherapy, although other authors do not confirm this²⁰. According to the ESMO, intraoperative radiotherapy remains an experimental method and is not recommended for standard use in patients with pancreatic tumors. The importance of extended lymphadenectomy in lymph node metastases is an independent prognostic factor that worsens the survival rate. Changes in one lymph node do not affect survival compared to those observed in patients without node metastases. Farnell et al. retrospectively analyzed the results obtained in over 400 patients operated on for adenocarcinoma of the pancreatic head. In their case, classic lymphadenectomy was extended to include removal of lymph nodes in the hepatic hilus, para-aortic nodes between the origin of the celiac trunk and the origin of the superior mesenteric artery, nodes located laterally from the origin of the renal arteries, and nodes of the entire circumference of the celiac trunk, superior

mesenteric artery and hepatoduodenal ligament. The authors did not observe any improvement in long-term survival after such surgery²¹. According to current recommendations, including those of the ESMO and the European Society of Digestive Oncology (ESDO), standard lymphadenectomy should be performed, covering the lymph nodes of the right side of the hepatoduodenal ligament, the common hepatic artery, the portal vein, the right side of the celiac trunk, and the right part of the superior mesenteric artery. Infiltration of the retroperitoneal space significantly increases the risk of local recurrence and thus reduces the patient's chances of a full recovery²². The term “mesopancreas” refers to tissue located retroperitoneally, outside the pancreas and portal veins, through which pancreaticoduodenal vessels and neural plexuses pass. It extends between the posterior surface of the head of the pancreas and the posterior surface of the superior mesenteric vein and the portal vein, along the right edge of the superior mesenteric artery and the celiac trunk, to the preaortic fascia²³. The results of the latest research confirm that the removal of this tissue during the Whipple operation significantly increases the percentage of R0 resections performed²⁴.

Treatment of pancreatic tumor with metastases in the liver

If metastases in the liver are only detected during surgery in a patient treated for a potentially resectable pancreatic tumor, they are classified for palliative treatment. However, advances in modern surgery make it possible to perform resection of the pancreas and liver during the same procedure. No randomized trials have been conducted, but the results of retrospective analyses show that the survival of patients after resection procedures is longer than in patients who only underwent palliative bypass. Klein et al. reported that the median survival time of patients after removal of liver metastases increased compared to that observed after palliative surgery alone. Liver resection undertaken at the same time as pancreatic resection did not increase perioperative mortality, which was below 5%. Such good results are only achieved in centers with extensive

experience in pancreatic and liver surgery. Complete simultaneous surgery of the pancreas and liver has a special role in patients with pancreatic neuroendocrine tumors - it increases long-term survival, therefore it is considered the optimal treatment in this group²⁵.

Use of minimally invasive surgical techniques

Due to the extraperitoneal location of the pancreas and its complex anatomical condition, progress in the introduction of minimally invasive techniques in pancreatic surgery has taken a relatively long time. There was concern that their use would increase the incidence of life-threatening complications, such as intraoperative bleeding or pancreatic fistulas. As surgeons have gained experience and improved surgical technique, it has become easier to avoid such complications. This is confirmed by the results obtained in centers with extensive experience in pancreatic surgery and the application of laparoscopic techniques. In the currently published papers, there are no differences in oncological outcomes between laparoscopic and open operations. Laparoscopic procedures, however, result in statistically significantly less blood loss, and thus less need for blood transfusion, fewer postoperative wound infections, fewer postoperative complications, and shorter hospital stay. It should also be noted that there has been a significant increase in the number of laparoscopic peripheral resections of the pancreas with preservation of the spleen²⁶.

Conclusion

The goal of modern surgical treatment of patients with pancreatic tumors is the complete removal of the tumor. The growing experience of surgeons and improved technical capabilities allow extensive resections to be performed without a statistically significant increase in perioperative complications. The results of retrospective analyses confirm a prolongation of survival time or an increase in the percentage of complete healing in patients who have undergone extended radical resection of the pancreas. Modern surgical treatment of malignant tumors asks multidisciplinary treatment.

The use of chemotherapy and radiotherapy enables an increase in the percentage of complete resections (R0). Great importance is attached to the wider application of laparoscopic techniques as minimally invasive, safe methods that represent a lower risk of perioperative complications, and enable the achievement of results comparable to those achieved after classical operations. In specialized centers, peripheral laparoscopic resection of the pancreas is now becoming a standard method of treatment for patients with tumors of the body or tail of the pancreas.

Conflict of interests

The author has no relevant financial or non-financial interest to disclose.

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